VISION IN WATER

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Purpose: To determine visual performance in water, including the influence of pupil size.
Method: The water environment was simulated by placing a goggle filled with saline in front of eyes, with apertures placed at the front of the goggle. Correction factors were determined for the different magnification under this condition to estimate vision in water. Experiments were conducted on letter visual acuity (7 participants), grating resolution (8 participants), and grating contrast sensitivity (1 participant).
Results: For letter acuity, mean loss in vision in water, compared to corrected vision in air, varied between 1.1 log minutes of arc resolution (logMAR) for a 1mm aperture to 2.2 logMAR for a 7mm aperture. The vision in minutes of arc was described well by a linear relationship with pupil size. For grating acuity, mean loss varied between 1.1 logMAR for a 2mm aperture to 1.2 logMAR for a 6mm aperture. Contrast sensitivity for a 2mm aperture deteriorated as spatial frequency increased, with 2 log unit loss by 3 cycles/degree. Superimposed on this deterioration were depressions (notches) in sensitivity, with the first three notches occurring at 0.45, 0.8 and 1.3 cycles/degree and with estimates for water of 0.39, 0.70 and 1.13 cycles/degree.
Conclusion: Vision in water is poor. It becomes worse as pupil size increases, but the effects are much more marked for letter targets than for grating targets.